Tesla Motors Australia, Pty. Ltd.
546 Gardeners Rd
Alexandria NSW 2015

Tiffany O'Keefe
Senior Policy Advisor
Australian Energy Market Commission
PO BOX A2449
Sydney South NSW 1235

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Dear Ms O'Keefe,

RE: Tesla's Response to the Draft Rule for Improving the NEM access standards – Package 2

Tesla Motors Australia, Pty Ltd (Tesla) welcomes the opportunity to provide feedback to the draft rule for the Improving the NEM access standards – Package 2.

Tesla is a global leader in electric vehicles and clean energy products, producing a vertically integrated suite of energy solutions including Powerwall, Megapack, and Superchargers. Tesla is also an established player in the data centre sector, with its Megapack product supporting more than half of major hyperscalers in the US — including Tesla's own 130 MW data centre at Gigafactory Texas, which has 130 MW/260 MWh of Megapack installed behind the meter and 125 MW/250 MWh installed in front of the meter, and the 250 MW xAI Colossus facility with AI load smoothing and demand response use cases.

The AEMC's draft determination on Package 2 for inverter-based loads (IBL) is timely as data centres of this scale begin to explore the Australian market. The NEM operates under a unique set of technical and regulatory arrangements, with generally weaker grid conditions than in the US. The draft rule introduces relevant guidance for IBLs looking to connect in the NEM, modernising the technical access standards framework while ensuring IBL integration supports secure and reliable power system operation.

Tesla is generally supportive of the full suite of recommendations in the draft determination, including the tiered approach for classifying large IBLs, the introduction of new disturbance ride-through requirements, and other power system security requirements. The main areas where Tesla suggests reconsideration, or at least further technical discussion, are ride-through requirements for generators in S5.2.5.5(u), control system instability requirements in S5.3.14(e), and the broader discussion areas of model validation and plant registration.

Tesla thanks the AEMC for the opportunity to engage through the consultation process and TWG meetings and welcomes further discussion on any aspect of this submission.

Kind regards,

Kaavya Jha
Senior Energy Policy Advisor

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2. System Security Risks from Large Load Connections

Tesla agrees with the AEMC's characterisation of the emerging system security risks from IBL. These loads have technical characteristics and dynamic plant behaviour that more closely resemble grid-following (GFL) inverter based resources (IBR) rather than traditional passive loads. Unlike conventional loads, IBLs can rapidly reduce or cease demand during voltage and frequency disturbances, with the potential to undermine system stability in a manner analogous to generator disconnection.

Tesla also welcomes AEMO's preliminary dynamic modelling, conducted in support of the TWG process and referenced in section 2.2.3 of the Draft Determination. This modelling demonstrates that following a credible voltage disturbance, aggregated IBL demand reduction can be comparable to, or exceed, the size of a major credible contingency event. The Commission is right to note that these impacts grow over time as more IBLs connect to the NEM. Critically, this aggregate risk is not confined to Tier 3 connections. The modelling shows that smaller IBLs concentrated in the same part of the network will respond identically during a disturbance, producing a significant combined effect regardless of individual nameplate size. This finding should be central to any consideration of relaxations for Tier 1 or Tier 2 connections discussed below.

3. Classifying and Defining Large IBL

Tiered Approach for Schedule 5.3 Plants

Tesla supports maintaining the existing framework for IBLs connecting at the transmission level or opting for registration under the NER, where the Schedule 5.3 access standards apply automatically in their entirety. Tesla similarly supports the principle of a tiered classification framework for distribution-connected IBL, as set out in section 3.2.2, recognising the practical variation in data centre size, network location and system security impact, although cautions that any inclusion of NSP discretion facilitates the connection process rather than add connection uncertainty within tier 2.

Modelling Requirements for Tier 3

The Draft Determination includes the suggestion that 'Tier 3 modelling to include PSCAD and PSSE studies…align with generator modelling obligations.' As AEMO continues to have these discussions, Tesla notes the that IBLs are still emerging in their modelling capabilities. High-fidelity dynamic modelling of data centres is extremely challenging due to the large number of internal components, nonlinear controls, and diverse operating modes. In practice, it may be infeasible to develop data centre dynamic models with a level of accuracy and validation comparable to conventional generator models, especially given the difficulty of benchmarking against measured responses.

At present, data provided for data centres typically consists of simplified load profiles (often static or Excel-based), which implicitly assume minimal interaction with grid dynamics. This level of modelling may not be sufficient if detailed dynamic behaviour is required. Consequently, the overall modelling risk should be explicitly linked to the availability and quality of data centre models, as we are not able to develop or validate such models on behalf of the data centre.

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Registration Requirements

While the AEMC decided not to introduce compulsory registration for IBL equal or greater to 30 MW, Tesla notes that this can lead to challenges across operational visibility, compliance enforcement, and system modelling, and welcomes further discussion on the most appropriate approach to IBL registration.

4. Disturbance Ride Through Requirements

New Requirements for IBL

S5.3.12 Response to frequency disturbances

Tesla is supportive of the proposed frequency disturbance ride-through access standard for IBL to stay connected during frequency disturbances aligned with the Frequency Operating Standard. Tesla sees this as a reasonable and achievable proposal for the AAS, while also welcoming the flexibility from removing a MAS, allowing the plant to the full capability to negotiate if it is unable to meet this.

S5.3.13 Response to voltage disturbances

Tesla is supportive of the proposed voltage disturbance ride-through access standard for IBL, which introduces a voltage ride-through curve, limits on increasing or decreasing active power or current during a disturbance, and timely active power recovery after a disturbance.

S5.3.3 Protection systems and settings

N/A. Tesla notes that while BESS do not use phase-shift-based tripping (< 20 degrees) or fault-count-based protection, compliance with this access standard will depends entirely on the data centre's site protection design.

Tesla notes the draft determination asks stakeholders whether the protection system requirements should be included in the automatic access standard only, to provide more flexibility for different IBL technologies. Tesla's preference is that S5.2 plant AAS protection requirements should not be directly imposed on S5.3 loads. Loads and plants serve fundamentally different system roles, and applying plant style protection obligations to loads may reduce flexibility for diverse IBL technologies rather than enhance it.

Additionally, Tesla questions the proposal to make S5.3.3 an AEMO advisory matter. Conventionally, load and network protection coordination is the responsibility of the NSP, rather than centrally mandated protection prescriptions for loads.

Clarifying Requirements for Generators

Tesla does not support the introduction of clause S5.2.5.5(u), under which NSPs would compile a list of credible and non-credible contingency events against which Schedule 5.2 participants must demonstrate ride-through capability.

Tesla notes that Package 1 already introduced challenges with the same clause: the system impedance tuning boundary nominated by the NSP uses fault level under N-1 conditions as a proxy for the dynamic voltage profile a plant will experience during a disturbance, which does not capture voltage angle dynamics, inter-machine control interactions or non-linear recovery behaviour, and can therefore be a poor predictor of actual ride-through performance.

The Package 2 list-based mechanism compounds this by layering an open-ended and potentially shifting set of simulation studies on top of that incomplete foundation — each event on the NSP's list requires separate EMT analysis under different initiating conditions, and the "likely to be reclassified" criterion for non-credible events provides no bounding definition, exposing plant designers to unbounded and uncertain compliance obligations prior to connection agreement. Tesla considers that a TWG process (with representation from S5.2 participants) should be convened to define what a technically justified and bounded set of disturbance conditions would look like before this provision is finalised.

5. Power System Stability and Protection Requirements

S5.3.14 – Instability monitoring and detection

The draft rule introduces new access standards for instability detection and response by loads. Tesla is supportive of the tiered approach taken in this proposal, as installation of PMUs for loads larger than 100 MW is feasible, subject to additional hardware costs. Similarly, there is no major technical or commercial barrier to install devices capable of detecting voltage, reactive power, and active power instability, and to trip on detected instability if required.

However, Tesla is not supportive of the subclause S5.3.14(e), which would require capabilities and control systems to ensure the operation of the S5.3 plant does not cause, exacerbate, or contribute to instability.

Control systems designed to actively avoid causing or contributing to instability represent a significant challenge. Traditionally, power systems are designed around loads whose power variations occur predominantly below ~1 Hz. In contrast, data centres can exhibit power variations with frequency content well above 10 Hz. This introduces new and largely uncharted stability challenges, requiring extensive analysis and study to properly address. Tesla recommends that this clause is discussed further in a TWG meeting.

6. System Strength Access Standards

S5.3.11 Short Circuit Ratio

Tesla is supportive of the proposal to limit the application of the short circuit ratio access standard to large IBLs and providing flexibility in the application of this access standard at an SCR value of 3.0 or a reasonably higher value agreed with the NSP and AEMO.

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7. Further NER Improvements

S5.3.10 Load shedding facilities

The draft rule introduces new automatic and minimum access standards for load shedding capability, which includes enabling the s5.3 plant to provide automatic interruptible load that is capable of being disconnected in blocks. Tesla is supportive of these proposals noting that data centres would be able to meet these with the addition of batteries and thus are technically feasible. This requirement would also add significant value to the grid because it strengthens power system resilience by delivering fast proportional demand response that improves frequency control reduces the risk of cascading outages and over shedding lowers the need for costly frequency control ancillary services from generators minimises unnecessary disruption to users and supports the secure integration of growing volumes of inverter based resources while keeping overall system costs down for consumers.

Model Validation

Another consideration is designing the appropriate connection framework for IBL is model validation, in the equivalent of the R2 process for generators, in which the plant has to show that the plant behaviour is aligned with the modelling during connection. Given that previous TWG discussions suggested the exclusion of auxiliary loads like cooling (which can be 30% of load) in the modelling requirements for demonstrating ride through requirements, this will lead to a significant misalignment in the validation stage, as the plant cannot turn off its cooling system to match the benchmark performance. Cooling systems often use VFDs (Variable Frequency Drives), motor controllers that regulate speed by varying electrical frequency and voltage. Because they're sensitive to frequency deviations and voltage disturbances, they respond dynamically during the exact grid events that R2 tests for — so their load behaviour during a compliance event won't match a model that excludes them.

Load Variation

A final area for future discussion is the process for IBLs that significantly change their load profile after connection. This includes shifts from stable load like cloud computing to less stable load profiles like AI training. Such changes can materially alter power system outcomes beyond the individual plant, so should consider how AEMO and NSPs can model the impact of these changes that protect grid security without being overly onerous on the proponent.